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EFFECT OF FEEDING TURNIPS ON THE FLAVOR AND ODOR OF MILK.

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OBJECT OF THE EXPERIMENT.

Dairymen realize the importance of succulent feeds in the ration of dairy cows and seek methods whereby a sufficient supply will be available the year round. Although silage and soiling crops are the most common succulent feeds, root crops are often found in the ration late in the fall and winter.

Like other succulent feeds,[1] root crops may have a tendency to impart undesirable flavors and odors to the milk. In order to determine whether such flavors and odors are imparted to the milk, feeding experiments were conducted by the Dairy Division at its experiment farm at Beltsville, Md.[2] The specific objects of the investigation were:

To determine whether feeding turnips affects the flavor and odor of milk.

If such is the case, to determine how turnips may be fed and the milk handled so as to minimize the effect, if objectionable, on the quality of the product.

PROCEDURE.

THE COWS.

The investigation was conducted with four Holstein and four Jersey cows. The cows selected were giving milk relatively free from abnormal flavors and odors, when fed the basic hay and grain ration.

[1] The effects of silage, green alfalfa, and green corn have been studied and reported in Department of Agriculture Bulletin No. 1097, "The Effect of Silage on the Flavor and Odor of Milk," and in Bulletin No. 1190, "The Effect of Feeding Green Alfalfa and Green Corn on the Flavor and Odor of Milk."

[2] The author acknowledges the assistance of T. E. Woodward, in charge of the Dairy Experiment Farm, Beltsville, Md., and H. T. Converse, dairy husbandman, who supervised the experimental work at the farm. Thanks are due also to members of the market milk section of the Dairy Division who judged the many samples of milk.

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They were representative of their respective breeds, the average weight of the Jerseys being 935 pounds, and that of the Holsteins 1,290 pounds.

During the experiment the average daily milk production of the Jersey cows was 16 pounds, the highest individual daily average being 18 pounds and the lowest 14.1 pounds. The Holstein cows gave an average daily milk production of 22.6 pounds, the highest average being 25.7 pounds and the lowest 19.5 pounds. The average daily milk production of all cows was 19.3 pounds.

TURNIPS.

The turnips fed were mostly rutabagas or "Swedes." There were, however, a few cow-horn turnips mixed with them. The turnips were stored for a short time before feeding.

FEED OTHER THAN TURNIPS.

In addition to turnips the cows received, in proportion to the amount of milk produced, varying amounts of the following grain mixture: Hominy feed, bran, and oats, 100 pounds each; cottonseed meal and linseed meal, 50 pounds each. The ration was completed by feeding the cows all the cured alfalfa hay they would readily consume. This varied considerably, ranging from 9.7 pounds to 16.6 pounds, depending on the amount of turnips the cows were receiving. The average daily amount of alfalfa consumed was 13.8 pounds.

METHOD OF FEEDING.

The cows were divided into groups of two each. One group received only the basic hay and grain ration, and were known as checks. The other three groups received, respectively, in addition to the hay and grain ration, the following amounts of turnips:

15 pounds 1 hour before milking.
30 pounds 1 hour before milking.
30 pounds immediately after milking.

The cows were fed these rations for six days, then for one day no turnips were fed, after which the cows in the various groups were interchanged in order to equalize any abnormal results due to the milk of an individual animal. The feeding of turnips was then resumed.

MILK SAMPLES.

Samples were taken from the milk of each cow at the time of milking, given a key number and cooled, but not aerated. The samples were judged for flavor and odor by experienced judges, who had no knowledge of the key. An "opinion," as this term is used in the following pages, denotes the decision of the judge in regard to one sample.

Using the term "off" to signify flavors and odors which the judges believed to be due to turnips, the following classification was used: Normal; very slightly off; slightly off; off. When no off flavor or odor was perceptible, the sample was rated normal; and when an off flavor or odor was perceived the sample was rated according to the degree which the judge considered it to be off. The average

consumer might have no serious objection to those samples rated as "slightly off"; and it is doubtful whether the flavors and odors rated as "very slightly off" would be noticed by persons other than those accustomed to judging milk and cream.

THE EXPERIMENTAL FEEDING.

CHECK SAMPLES.

The check samples were taken from the milk of the check cows, which were fed only the basic hay and grain ration. A few off flavors and odors were noted in these samples, but they were very slight, and undoubtedly were instances of the slightly off flavors and odors which are frequently found in milk from individual cows.

Out of a total of 285 opinions obtained on 50 check samples, 97.5 per cent of the opinions on flavor and 94 per cent of those on odor

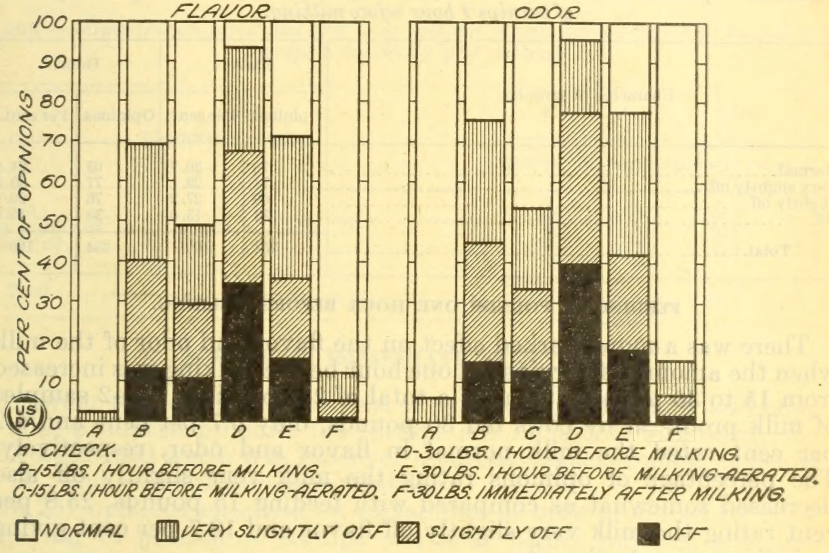

FIG. 1.—Effect of feeding turnips on flavor and odor of milk.

showed a normal condition. All the off flavors and odors, that is, 2.5 per cent of the opinions on flavor and 6 per cent of those on odor, were rated as very slightly off. (See Table 1 and fig. 1.)

TABLE 1.—*Opinions on flavor and odor of 50 samples of milk from cows fed basic rations of hay and grain (check cows).*

Character of samples.	Flavor.		Odor.	
	Opinions.	Per cent.	Opinions.	Per cent.
Normal	278	97.5	268	94.0
Very slightly off	7	2.5	17	6.0
Slightly off	0	0	0	0
Off	0	0	0	0
Total	285	100	285	100

FEEDING 15 POUNDS ONE HOUR BEFORE MILKING.

Feeding 15 pounds of turnips, which constitute about half of a full feed, affected the flavor and odor of the milk. In a total of 254 opinions on 45 samples of milk produced by cows receiving this quantity of turnips, 30.7 per cent of the opinions on flavor and 24.8 per cent of those on odor rated the milk as normal. Opinions on flavor were about equally divided between very slightly off and slightly off, 29.1 per cent rating the samples very slightly off and 27.2 rating them slightly off, while 13 per cent rated them off.

Off odors were more readily perceived than off flavors, a somewhat larger percentage of opinions rating the samples off in odor than in flavor. The ratings for odor were 30.3 per cent, 29.9 per cent, and 15 per cent for very slightly off, slightly off, and off, respectively. (See Table 2 and fig. 1.)

TABLE 2.—*Opinions on flavor and odor of 45 samples of milk from cows fed 15 pounds of turnips 1 hour before milking.*

Character of samples.	Flavor.		Odor.	
	Opinions.	Per cent.	Opinions.	Per cent.
Normal	78	30.7	63	24.8
Very slightly off	74	29.1	77	30.3
Slightly off	69	27.2	76	29.9
Off	33	13.0	38	15.0
Total	254	100	254	100

FEEDING 30 POUNDS ONE HOUR BEFORE MILKING.

There was a more marked effect on the flavor and odor of the milk when the amount of turnips fed one hour before milking was increased from 15 to 30 pounds. Out of a total of 240 opinions on 42 samples of milk produced by cows fed 30 pounds, only 6.7 per cent and 4.2 per cent rated the milk normal in flavor and odor, respectively. The percentage of opinions rating the milk very slightly off also decreased somewhat as compared with feeding 15 pounds, 25.8 per cent rating the milk very slightly off flavor and 18.7 per cent giving a similar rating to the odor.

TABLE 3.—*Opinions on flavor and odor of 42 samples of milk from cows fed 30 pounds of turnips 1 hour before milking.*

Character of samples.	Flavor.		Odor.	
	Opinions.	Per cent.	Opinions.	Per cent.
Normal	16	6.7	10	4.2
Very slightly off	62	25.8	45	18.7
Slightly off	80	33.3	90	37.5
Off	82	34.2	95	39.6
Total	240	100	240	100

By increasing the amount of turnips from 15 to 30 pounds, the opinions rating the milk as slightly off and off on flavor were increased from 27.2 to 33.3 per cent and from 13 to 34.2 per cent; and those rating the milk as slightly off and off on odor increased from 29.9

to 37.5 per cent and from 15 to 39.6 per cent, respectively. (See Table 3 and fig. 1.)

FEEDING 30 POUNDS IMMEDIATELY AFTER MILKING.

Feeding turnips at the rate of 30 pounds immediately after milking has but little detrimental effect on the flavor and odor of milk. A total of 232 opinions on 41 samples of milk produced by cows receiving this amount after milking showed that 87.9 per cent of the opinions rated the samples, taken at the next milking, as normal in flavor and 84.5 per cent as normal in odor. Of the opinions designating off flavors and odors, those rating the samples as very slightly off showed the higher percentage, 6.9 per cent representing flavor and 8.6 per cent representing odor, while 4.3 and 0.9 per cent of the opinions rated the flavor slightly off and off, respectively, and 5.2 and 1.7 per cent gave the same ratings to the odor. (See Table 4 and fig. 1.)

TABLE 4.—*Opinions on flavor and odor of 41 samples of milk from cows fed 30 pounds of turnips immediately after milking.*

Character of samples.	Flavor.		Odor.	
	Opinions.	Per cent.	Opinions.	Per cent.
Normal	204	87.9	196	84.5
Very slightly off	16	6.9	20	8.6
Slightly off	10	4.3	12	5.2
Off	2	.9	4	1.7
Total	232	100	232	100

EFFECT OF IMMEDIATE AERATION.

In order to determine the effect of aeration on the flavor and odor of milk produced by cows fed turnips one hour before milking, the milk while still warm was run over a surface cooler, cooling it below 45° F., and samples were again taken.

In 251 opinions obtained on 43 samples of milk produced by cows receiving 15 pounds of turnips one hour before milking, the percentage of opinions rating the milk normal in flavor was increased by aeration from 30.7 to 51 per cent, and the percentage rating the milk normal in odor was increased from 24.8 to 46.6 per cent. Before aeration 13 per cent of the opinions rated the milk off in flavor, which was reduced to 10.4 per cent by aeration. Likewise, the percentage of opinions rating the flavor as slightly off was reduced from 27.2 to 19.1 per cent, and the percentage rating it very slightly off was decreased from 29.1 to 19.5 per cent.

Aeration had a similar effect on the odor of the milk. Before aeration 15 per cent of the opinions rated the samples off, which was reduced to 12.8 per cent, and 29.9 per cent rated the milk slightly off, which was reduced to 20.7 per cent, while those rating it very slightly off were reduced from 30.3 to 19.9 per cent. (Compare Table 5 with Table 2 and see fig. 1.)

When 30 pounds of turnips were fed one hour before milking, aeration had a still more marked effect on the flavor and odor of the milk. In 249 opinions obtained on 42 samples of milk produced by cows receiving 30 pounds of turnips before milking, the percentage

of opinions rating the milk normal in flavor was increased from 6.7 to 28.9 per cent, and those rating the milk normal in odor were increased from 4.2 to 22.9 per cent.

TABLE 5.—*Opinions on flavor and odor of 43 samples of aerated milk from cows fed 15 pounds of turnips 1 hour before milking.*

Character of samples.	Flavor.		Odor.	
	Opinions.	Per cent.	Opinions.	Per cent.
Normal	128	51.0	117	46.6
Very slightly off	49	19.5	50	19.9
Slightly off	48	19.1	52	20.7
Off	26	10.4	32	12.8
Total	251	100	251	100

The percentage of opinions rating the samples very slightly off in flavor was increased from 25.8 to 35.7 per cent, and the percentage rating the samples very slightly off in odor was increased from 18.7 to 35.3 per cent by aeration. Before aeration 34.2 per cent of the opinions rated the samples off in flavor, which was reduced to 15.7 per cent after aeration. Likewise the percentage of opinions rating the milk as slightly off in flavor was reduced from 33.3 to 19.7 per cent.

A similar effect took place with the odor. Before aeration 39.6 per cent of the opinions rated the milk off in odor, which was reduced to 18.1, and 37.5 per cent rated it slightly off which was reduced to 23.7 per cent by aeration. (Compare Table 6 with Table 3, and see fig. 1.)

TABLE 6.—*Opinions on flavor and odor of 42 samples of aerated milk from cows fed 30 pounds of turnips 1 hour before milking.*

Character of samples.	Flavor.		Odor.	
	Opinions.	Per cent.	Opinions.	Per cent.
Normal	72	28.9	57	22.9
Very slightly off	89	35.7	88	35.3
Slightly off	49	19.7	59	23.7
Off	39	15.7	45	18.1
Total	249	100	249	100

EFFECT OF FEEDING TURNIPS ON THE FLAVOR AND ODOR OF CREAM.

After aeration, some of the milk produced by cows receiving 30 pounds of turnips one hour before milking was set aside for 24 hours, after which samples of cream were skimmed off by hand and judged for flavor and odor. A higher percentage of off flavors and odors was found in this cream than in the aerated milk from which the cream was obtained. Very slightly off and slightly off flavors and odors, however, were less frequent in the cream than in the milk.

Out of a total of 81 opinions on 15 samples of cream skimmed from the aerated milk, 32.1 per cent rated the cream normal in flavor and 24.7 per cent rated it normal in odor. This is practically the same as the milk from which it was skimmed, as 30.9 per cent

rated the milk normal in flavor and 25.9 per cent rated it normal in odor. Of the opinions designating very slightly off and slightly off flavors and odors, the greater percentage rated the milk in these groups: 40.7 and 21 per cent rated the flavor of the milk very slightly off and slightly off, respectively, while 23.5 and 18.5 per cent gave similar ratings to the cream. Likewise, 39.5 and 24.7 per cent of the opinions rated the odor of the milk very slightly off and slightly off, respectively, while 24.7 and 18.5 per cent gave similar ratings to the cream. The opinions rating the cream off in flavor and odor showed a higher percentage than those giving a similar rating to the milk; 25.9 and 32.1 per cent rating the cream off in flavor and odor, respectively, while only 7.4 and 9.9 per cent gave similar ratings to the milk. It appears, therefore, that when off flavors and odors are present in milk, these flavors and odors are more pronounced in the cream from such milk. (See Table 7 and fig. 2.)

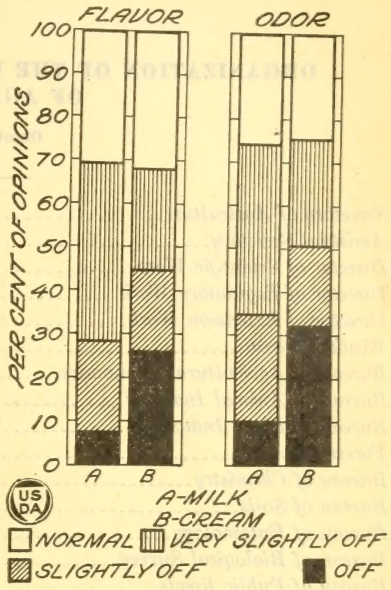

FIG. 2.—Relative effect on milk and cream.

TABLE 7.—*Opinions on flavor and odor of 15 samples of aerated milk and cream from cows fed 30 pounds of turnips 1 hour before milking.*

Character of samples.	Flavor.				Odor.			
	Milk.		Cream.		Milk.		Cream.	
	Opinions.	Per cent.	Opinions.	Per cent.	Opinions.	Per cent.	Opinions.	Per cent.
Normal	25	30.9	26	32.1	21	25.9	20	24.7
Very slightly off	33	40.7	19	23.5	32	39.5	20	24.7
Slightly off	17	21.0	15	18.5	20	24.7	15	18.5
Off	6	7.4	21	25.9	8	9.9	26	32.1
Total	81	100	81	100	81	100	81	100

CONCLUSIONS.

Feeding turnips to dairy cows at the rate of 15 pounds one hour before milking produces objectionable off flavors and odors in the milk.

Increasing the amount of turnips fed one hour before milking from 15 to 30 pounds, increases to a very marked degree the intensity of the off flavors and odors produced in the milk.

Feeding turnips at the rate of 30 pounds immediately after milking has but little detrimental effect on the flavor and odor of the milk.

Proper aeration reduces strong off flavors and odors in milk, caused by feeding turnips, and some of the slight off flavors and odors may be eliminated.

The off flavors and odors produced by feeding turnips are more pronounced in the cream than in the milk.

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October 15, 1923.

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